US Environmental Protection Agency Radiation Protection Programs for Waste Management and Site Cleaup - 8101

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ABSTRACT

This paper provides an overview of the regulatory authorities of the Environmental Protection Agency's (EPA's) Office of Radiation and Indoor Air (ORIA) as they pertain to radioactive waste management and disposal, and cleanup of radioactively contaminated sites. It also describes several ORIA initiatives and examples of two of EPA's radioactive waste standards.

INTRODUCTION

As a result of increasing concern for the condition of the environment and the impact of pollution on the biosphere, the U.S. Environmental Protection Agency (EPA) was established on 2 December 1970. The EPA was established to consolidate in one agency a variety of federal research, monitoring, standard-setting, and enforcement activities to ensure environmental protection. The EPA's mission is to protect human health and to safeguard the natural environment—air, water, and land—upon which life depends.

From regulating auto emissions to banning the use of DDT; from cleaning up toxic waste to protecting the ozone layer; from increasing recycling to regulating exposure to radiation, EPA's achievements have resulted in cleaner air, purer water, and better protected land.

Within EPA, the Office of Radiation and Indoor Air (ORIA), as a part of the Office of Air and Radiation, is the only office with its sole mission to protect people and the environment from harmful and avoidable exposure to radiation.

LEGAL AUTHORITIES AND RESPONSIBILITIES FOR ORIA

Public Health Service Act (PHSA)

The PHSA [1] provides EPA with the authority to conduct monitoring of environmental radiation, perform research on the environmental and human health effects of exposure to radiation, and provide training and technical assistance to the States. Under Reorganization Plan No. 3 of 1970, EPA was assigned the authority of Section 311(c)(1) to develop, and implement as needed, a plan to effectively provide personnel, equipment, medical supplies, or other Federal resources to respond to health emergencies.

Atomic Energy Act, as amended (AEA)

The AEA [2] established the Atomic Energy Commission (AEC) to promote the "utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public." Under Reorganization Plan No. 3, EPA was transferred the authority of the AEC for "establishing generally applicable environmental standards for the protection of the general environment from radioactive materials. As used herein, standards mean limits on radiation exposures or levels, concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material." The EPA also received the authority of the Federal Radiation Council to "advise the President with respect to radiation matters, directly or indirectly affecting health, including guidance for all Federal agencies in the formulation of radiation standards and in the establishment and executions of programs of cooperation with the states."

Clean Air Act, as amended (CAA)

The CAA of 1977 [3] directed EPA to review all relevant information and determine whether emissions of radioactive pollutants into ambient air will cause or contribute to air pollution that may reasonably be anticipated to endanger public health. Section 112 required EPA to publish and revise a list of hazardous air pollutants, and to develop a program to promulgate, implement, and enforce emission standards for listed pollutants. The Administrator was directed to establish national emission standards "at the level [that] in his judgment provides an ample margin of safety to protect public health." This gave EPA the authority to develop its National Emission Standards for Hazardous Air Pollutants (NESHAPs) for radionuclides. In addition, the listing of radionuclides as hazardous pollutants meant that the emergency response requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, see below) also applied to accidental releases of radioactive material. Section 103 of the CAA also provides EPA broad authority to gather information, provide grants, conduct or promote research, and coordinate and accelerate training.

Clean Water Act, as amended (CWA)

The primary objective of the CWA [4] is to restore and maintain the integrity of the nation's waters. The CWA requires major industries to meet performance standards to ensure pollution control; charges States and Tribes with setting specific water quality criteria appropriate for their waters and developing pollution control programs to meet them; provides funding to States and communities to help them meet their clean water infrastructure needs; and protects valuable wetlands and other aquatic habitats through a permitting process that ensures that development and other activities are conducted in an environmentally sound manner. Section 311 of the CWA provides the Administrator the authority to initiate and direct responses to any accidental releases of oil or hazardous substances when there is a substantial threat to the public health or welfare. The National Contingency Plan (NCP) [5] implements the emergency response requirements of Section 311 of the CWA.

Safe Drinking Water Act, as amended (SDWA)

The SDWA [6] requires EPA to promulgate and enforce primary standards for contaminants, including radionuclides, in public water systems. Initially, EPA was to set interim regulations for a limited group of contaminants and later revise those regulations and set standards for the remaining contaminants. The 1986 amendments required EPA to develop maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs) concurrently and to finalize the interim regulations. Under this statute EPA may delegate program enforcement authority to the States. The 1996 amendments to the SDWA directed EPA to: withdraw the proposed National Primary Drinking Water Regulations (NPDWR), including the proposed MCLG and MCL and monitoring, reporting, and public notification requirements for radon, due to the controversy over the cost-benefit basis for the proposed standard; arrange for the NAS to conduct a formal study of radon in drinking water; publish a risk reduction and cost analysis for possible radon MCLs by February 1999; promulgate the radon MCLG and NPDWR for drinking water by the year 2000; develop an alternative MCL for radon, as directed to ensure that any revised drinking water standard will maintain or increase public health protection; and review all drinking water regulations every six years.

The SDWA also provides EPA with emergency response authority. Section 1431(a) directs the Agency to take the necessary actions to protect the public health during emergencies that affect public drinking water supplies.

Comprehensive Environmental Response, Compensation, and Liability Act, as amended (CERCLA)

The CERCLA [7] (commonly known as Superfund) created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances, pollutants, and contaminants that may endanger public health or the environment. The CERCLA defines hazardous substances by reference to other lists. Since the CAA list radionuclides as hazardous substances, they are covered by CERCLA.

The CERCLA authorizes two kinds of response actions: short-term removals where actions may be taken to address releases or threatened releases requiring prompt response; and long-term remedial response actions that permanently and significantly reduce the dangers associated with releases or threats of releases of hazardous substances that are serious, but not immediately life threatening. Long-term remedial response actions can be conducted only at sites listed on EPA's National Priority List (NPL) [8].

Short-term removal actions (emergency responses) may be taken at any site at which a release or threatened release occurs. These response actions are conducted in accordance with the concept of operations contained in the NCP (40 CFR Part 300). Section 105 of CERCLA requires the development of the NCP. The CERCLA applies to radiological events at Department of Defense (DoD) and Department of Energy (DOE) facilities, but does not apply to releases from Nuclear Regulatory Commission (NRC)-licensed facilities subject to the requirements of the Price Anderson Amendments of the AEA.

Nuclear Waste Policy Act (NWPA)

The NWPA [9] provides the basis for the current national program for the disposal of spent nuclear fuel (SNF) and high-level waste (HLW). The Act established formal procedures to evaluate and select sites for geologic repositories, as well as procedures for the interaction of State and Federal governments. It provides a timetable of key milestones the Federal agencies must meet in implementing the program.

The NWPA assigns DOE the responsibility for siting, building, and operating a deep geologic repository for the disposal of HLW and SNF. It directs EPA to "promulgate generally applicable standards for protection of the general environment from offsite releases of radioactive material in repositories." The NRC is to license DOE to operate a repository that meets EPA's standards and all other relevant requirements.

Nuclear Waste Policy Amendments Act (NWPAA)

The NWPAA [10] directs DOE to consider Yucca Mountain as the primary site for the first geologic repository for HLW and SNF, and prohibits DOE from conducting site-specific activities at a second site, unless authorized by Congress. It also requires the Secretary of Energy to develop a report on the need for a second repository no later than January 1, 2010.

Waste Isolation Pilot Plant Land Withdrawal Act, as amended (WIPP LWA)

The WIPP LWA [11] reinstated the disposal standards that were issued by the Agency in 1985 and remanded in 1987, except for two sections, and directed EPA to issue final disposal standards (which the Agency did in 1993). It also directed that the disposal standards in 40 CFR Part 191 would not apply to any site characterized under section 113(a) of the NWPA (e.g., Yucca Mountain).

This Act also provided an extensive role for EPA oversight of DOE activities at WIPP. Specifically, EPA was required to: issue final standards for disposal of spent nuclear fuel, high-level radioactive waste, and TRU waste (see 40 CFR Part 191 below); develop criteria specifically for WIPP that implement the final disposal standards; certify that the WIPP is in compliance with 40 CFR Part 191, if DOE satisfies the criteria; reevaluate WIPP every five years to determine whether it should be recertified; and ensure that WIPP complies with other environmental and public health and safety regulations every two years.

The 1996 WIPP LWA amendments dictated three major items. The WIPP LWA amendments specified 30 November 1997 as a non-binding date for the WIPP site to open, pending certification by EPA that the site meets environmental regulatory requirements; exempted WIPP from RCRA Land Disposal Requirements; and withdrew requirements in the original Act that required DOE to conduct underground tests on-site with transuranic waste to determine whether it could be disposed of safely.

Energy Policy Act (EnPA)

The EnPA [12] requires EPA to "promulgate standards to ensure protection of public health from high-level radioactive wastes in a deep geologic repository that might be built under Yucca Mountain in Nevada." EPA is further directed to issue these site-specific public health and safety standards, "based upon and consistent with the findings and recommendations of the National Academy of Sciences…."

As noted above in the NWPA section, there are three principal Federal agencies involved in various aspects of the Yucca Mountain Project. In the EnPA, Congress continued the roles established in the NWPA. That is, it gave EPA the responsibility to set the environmental standards for the facility. We accomplished that in 2001 by establishing "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV" at 40 CFR Part 197 [13]. The NRC has the responsibility to determine whether waste would be stored and disposed of in compliance with 40 CFR Part 197 and, thus, whether Yucca Mountain should be licensed to operate. The DOE is responsible for designing, building, applying for a license for, and operating Yucca Mountain, if it is approved to open.

THE FEDERAL RADIOACTIVE WASTE SYSTEM AND EPA'S ROLE IN IT

There are three main Federal government agencies involved in the oversight, licensing, siting, and operations of the Federal radioactive waste management and disposal system – EPA, NRC, and DOE. There are others, e.g., the United States Geological Survey, but their roles are not directly related to EPA's and are not described herein.

Environmental Protection Agency (EPA)

The EPA's mission is to protect human health and to safeguard the natural environment — air, water, and land — upon which life depends on both national and global levels. EPA's radiation protection responsibilities originate from the AEA and related statutes (see above). Under the authority of those statutes, EPA develops generally applicable radiation protection standards for Federal and State organizations to incorporate into the development of their regulations; develops regulations that implement these standards (e.g., Criteria for Certification and Re-Certification of WIPP Compliance with 40 CFR 191 Disposal Regulations [14]); develops guidance for all Federal agencies in the formulation of radiation standards; establishes and executes cooperative programs with the States; measures radiation in the environment; and engages in public outreach to inform people about radiation. The EPA also develops, implements, and enforces media-specific regulations for mixed chemical and radioactive environmental pollutants and engages in the clean-up of sites contaminated with both chemical and radioactive materials. One exception to the authority to develop generally applicable standards is the authority given to EPA by the EnPA to set site-specific standards for Yucca Mountain, Nevada.

Nuclear Regulatory Commission (NRC)

The NRC's mission is to ensure protection of public health and safety, the common defense and security, and the environment in the use of certain radioactive materials. The NRC licenses commercial facilities including nuclear power reactors; non-power research, test, and training reactors; fuel cycle facilities; medical, academic, and industrial uses of nuclear materials; and the transport, storage, and disposal of commercial nuclear materials and waste. Under the authority of the AEA, NRC is responsible for developing, implementing, and enforcing its licensing requirements and EPA's radiation protection standards. The one exception to this is that EPA implements its own standards for WIPP.

Department of Energy (DOE)

The DOE's mission is to develop and implement a coordinated national energy policy to ensure the availability of adequate energy supplies and to develop new energy sources for domestic and commercial use. In addition, DOE is responsible for developing, constructing, providing materials for, and testing of nuclear weapons and power for the U.S. military; for managing low- and high-level radioactive wastes generated by past nuclear weapons production, research programs, and nuclear propulsion; and for siting, applying for licenses, constructing and maintaining disposal facilities for its radioactive wastes, including WIPP for transuranic radioactive wastes and the potential repository for SNF and HLW at Yucca Mountain, Nevada. The DOE develops its own standards under the authority of the AEA (known as DOE Orders) and is responsible for enforcing those as well as EPA's standards at some of its facilities.

STANDARDS AND POLICY DEVELOPMENT

Yucca Mountain, Nevada

The potential facility, including both storage facilities and a deep geologic repository, at Yucca Mountain, will become the disposal site for spent nuclear fuel and high-level radioactive waste in the United States if DOE submits a license application and NRC issues a license. Currently, SNF and HLW are stored aboveground at 77 locations in the United States, including 72 commercial nuclear power plants and five DOE facilities. The EPA's role at Yucca Mountain is to set the radiation protection standards for the public. The EPA standards that apply to Yucca Mountain are entitled *Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada*. These standards are found in 40 CFR Part 197. Details of 40 CFR Part 197 are the subject of a section later in this paper.

The Waste Isolation Pilot Plant, New Mexico

The WIPP is the only operational deep geologic repository in the United States. It is operated by DOE. The only waste eligible for emplacement is transuranic radioactive waste that was produced in the defense programs. The WIPP is the only operational radioactive waste facility over which EPA has enforcement authority; WIPP was first certified for operation by EPA in 1998. The EPA standards used by EPA are found in 40 CFR Part 191, *Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*. To implement these standards, EPA developed 40 CFR Part 194, *Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations*. The EPA also carries out inspections of the generator sites, to assure that waste preparation and quality assurance requirements are being met.

Low-Activity Mixed Waste

Mixed waste contains radioactive and chemically hazardous waste. A dual regulatory framework exists for mixed waste, with EPA or authorized States regulating the chemically hazardous waste, and NRC agreement states or DOE regulating the radioactive waste. The NRC generally regulates commercial and non-DOE federal facilities. The DOE is currently self-regulating and its orders apply to DOE sites and contractors.

In 2001, EPA finalized regulations to provide increased flexibility to facilities that manage low-level mixed waste (LLMW) and technologically enhanced naturally occurring and/or accelerator-produced radioactive material (NARM) that contain chemically hazardous waste [15]. The final rule reduces dual regulation of LLMW, which is subject to the Resource Conservation and Recovery Act (RCRA) and to the Atomic Energy Act (AEA). This final rule conditionally exempts LLMW during storage and treatment from RCRA requirements. The storage and treatment exemption in today's rule requires the use of tanks or containers to store or treat the waste and applies only to LLMW that meets the specified conditions and is generated under a single NRC or NRC Agreement State license.

It also exempts LLMW and hazardous NARM waste from EPA’s manifest, transportation, and disposal requirements when specified conditions are met. Under this conditional exemption, the waste remains subject to manifest, transport, and disposal requirements under the NRC (or NRC Agreement State) regulations for low-level radioactive waste (LLW) or eligible NARM.

Technologically Enhanced Naturally Occurring Radioactive Material

Naturally occurring radioactive material (NORM) consists primarily of material containing potassium-40 and isotopes belonging to the primordial series. The principal primordial radionuclides are isotopes of heavy elements belonging to the radioactive series headed by the three long-lived isotopes uranium-238 (uranium series), uranium-235 (actinium series), and thorium-232 (thorium series). The NORM wastes are the radioactive residues from the extraction, treatment, and purification of minerals, petroleum products, or other substances obtained from parent materials that may contain elevated concentrations of primordial radionuclides. Technologically enhanced NORM (TENORM) is produced when radionuclides that occur naturally in ores, soils, water, or other natural materials are concentrated or exposed to the environment by human activities, such as uranium mining or sewage treatment (see Waterborne Radionuclides below).

The EPA is working to understand the problem and to develop effective ways to protect humans and the environment from harmful exposure to the radiation from these materials. The Agency is working on the problem in four ways: (10 studying the TENORM-producing industries to determine what's in the wastes from the industries and how much risk they pose; (2) identifying and studying existing TENORM sites to assemble a nation-wide view of the problem--where the wastes are, what's in them, and the risks they present; (3) developing and providing education and guidance for safely and economically controlling exposures to TENORM wastes; and (4) working with other organizations that are also confronting the problem, including States, Tribes, federal agencies, industry, environmental groups, and international organizations.

Multi-Agency Radiation Survey and Site Investigation Manual

The Multi-Agency Radiation Surveys and Site Investigation Manual (MARSSIM) [16] provides detailed guidance for planning, implementing, and evaluating environmental and facility radiological surveys conducted to demonstrate compliance with a dose- or risk-based regulation. MARSSIM focuses on the demonstration of compliance during the final status survey following scoping, characterization, and any necessary remedial actions. MARSSIM is flexible enough to use with many existing statutory programs. Its comprehensive guidance addresses all phases of the surface soil survey process for demonstrating compliance with dose- or risk-based requirements: planning, conducting, evaluating, and documenting.

The EPA, DOE, NRC and DoD were the primary developers of MARSSIM, but many individuals and other organizations also contributed to its development. In addition to the agencies that developed it, the users of MARSSIM include States, site owners, contractors, and the public.

Multi-Agency Radiation Laboratory Protocols Manual

The Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) [17] addresses the need for a nationally consistent approach to producing radioanalytical laboratory data that meet a project's or program's data requirements. MARLAP provides guidance for the planning, implementation, and assessment phases of those projects that require the laboratory analysis of radionuclides. The guidance provided by MARLAP is both scientifically rigorous and flexible enough to be applied to a diversity of projects and programs. This guidance is intended for project planners, managers, and laboratory personnel. It was developed by EPA, DOE, NRC, DoD, the National Institute of Standards and Technology, the U.S. Geological Survey, the U.S. Food and Drug Administration, and the States of Kentucky and California.

Federal Guidance

Federal Guidance is a set of guidelines developed by EPA, for use by Federal and State agencies responsible for protecting the public from the harmful effects of radiation. Federal guidance helps protect both the general public and the people who work with and around radiation every day. There are two kinds of Federal Guidance publications: (1) guidance documents that provide principles and policies for radiation protection and (2) technical reports that provide current scientific and technical information for radiation dose and risk assessment.

Federal Guidance is signed by the President and issued by EPA. By signing these, the President provides a framework for Federal and State agencies to develop regulations that ensure the public is protected from the harmful effects of ionizing radiation. Federal Guidance is also an opportunity for the President to promote national consistency in radiation protection regulations; whereas, Federal Guidance technical reports are issued by EPA. The technical reports ensure that agencies and the public are up-to-date on scientific and technical advances in radiation protection.

Airborne Releases

Under the CAA, EPA has the authority to limit releases of radionuclides into the air. These limits are referred to as NESHAPs. The emissions falling under this authority are: radon-222 from underground uranium mines; radionuclides, other than radon, from DOE facilities; radionuclides from federal facilities that are not regulated elsewhere; polonium-210 and lead-210 from phosphorus plants; radon-222 from DOE storage or disposal facilities for radium-containing materials; radon from phosphogypsum stacks; radon-222 from uranium mill tailings piles that are no longer operational; and radon-222 from current uranium mill tailings.

Waterborne Radionuclides

Most drinking water sources have very low levels of radionuclides, most of which are naturally occurring, although contamination of drinking water sources from human-made nuclear materials can also occur. Most radioactive contaminants are at levels that are low enough to not be considered a public health concern. At higher levels, long-term exposure to radionuclides in drinking water may cause cancer. In addition, exposure to uranium in drinking water may cause toxic effects to the kidney. To protect public health, EPA has established drinking water standards for several types of radioactive contaminants: combined radium-226 and -228 (5 picocuries per liter (pCi/L)); beta emitters (4 mrem/year); gross alpha emitters (15 pCi/L); and uranium (30 micrograms/L).

In treating water for domestic uses, drinking water treatment plants may accumulate radionuclides in waste materials because, as noted in the previous paragraph, surface and underground sources of water may contain small amounts of radionuclides, e.g., uranium, radium, thorium, and potassium. As the water is treated or filtered to remove impurities, the impurities may collect in filters, tanks, and pipes at the water treatment plant. The small amounts of radionuclides present may concentrate in sediment or sludges and mineral scales. Because the radionuclides are concentrated due to human activity, the waste is classified as TENORM. Most of this waste is disposed in landfills and lagoons, or is applied to agricultural fields. In recognition of this, EPA has developed guidance for State and local regulators on managing radioactive materials in drinking water treatment plants. The guidance covers technologies for treating and removing radionuclides from drinking water; general principles of radioactivity; recommendations for occupational safety of workers at community water systems (CWSs) including guidance for radiation protection and protection from radon; and regulatory requirements governing the radioactive wastes generated by the CWSs.

Similarly, water and wastes which have been discharged from residences and businesses into municipal sewers are treated at wastewater treatment plants. The discharged water and wastes may contain both man-made and naturally occurring radionuclides which can accumulate in the treatment plant, its sludges, and solid wastes.

As a member of the Federal government's Interagency Steering Committee on Radiation Standards (ISCORS), EPA joined NRC in conducting a multi-year survey on the occurrence of radionuclides in wastewater (sewage) treatment plants. One of the group's reports makes recommendations to operators of publicly-owned treatment works (POTW) on determining whether radioactive materials in sludge or ash, including TENORM and radon, could threaten the health and safety of POTW workers or the general public. From its survey results, ISCORS concluded that radiation levels in sewage sludge and ash at most POTW do not present an exposure concern to workers or to the general public. It also concluded that the radiation levels are low enough that sludge and ash are safe to be soil amendments for growing food crops.

FIELD SUPPORT ACTIVITIES

RadNet

The RadNet system consists of sampling stations in each State that regularly collect air particulate, surface water, drinking water, precipitation, and milk samples for radioactivity analyses. The system can also track airborne radioactivity from an accidental release. If necessary, the RadNet sampling frequency can be increased to meet the needs of a radiological emergency response. Since Chernobyl, EPA has participated in the World Health Organization's efforts to develop a global environmental monitoring program. The EPA plans to place as many as 180 RadNet air particulate monitors in cities across the Nation. These monitors will be capable of performing gamma spectrometry and determining gross beta radiation levels in near-real time on the airborne particulates collected on a fixed filter. The focus of the system is detection and quantification of radioactive contamination transported by air in cities not directly affected by the accident/incident.

Environmental Radiation Analysis

The EPA's primary laboratory for analyzing radiation in environmental samples is the National Air and Radiation Environmental Laboratory (NAREL). The NAREL is a comprehensive environmental laboratory managed by ORIA. The NAREL is located in Alabama. It provides services to a wide range of clients, including other EPA offices and Federal and State agencies. Its facilities incorporate state-of-the-art laboratory technology and equipment and include the latest health and safety techniques, as well as strict monitoring and control of laboratory emissions. Each year, the staff performs over 12,000 analyses on samples for a number of radionuclides and hazardous materials. Typical samples include air, water, soil, vegetation, tissue, and food. The NAREL routinely provides analytical and technical support for the characterization and cleanup of Superfund and Federal Facility sites. The NAREL staff is composed of highly trained professionals with backgrounds in health physics, radiochemistry, engineering, biology, mathematics, and computer science. Fundamental to the laboratory's mission is the commitment to developing and applying the most advanced methods for measuring environmental radioactivity and evaluating its risk to the public.

Mobile Laboratories

The Radiation and Indoor Environments National Laboratory (RIENL) is dedicated to protecting the public and the environment by minimizing exposure to radiation and indoor air pollution through environmental measurements, applied technologies, and education. As is NAREL, RIENL is managed by ORIA, but is located in Nevada.

The RIENL specializes in developing, demonstrating, and employing field technologies. The technical staff supports the cleanup of contaminated sites using state-of-the-art fixed and mobile laboratories, monitoring vehicles, and an extensive collection of calibrated field instruments. The RIENL staff also conducts field studies in radiation-contaminated areas and provides site-specific computer modeling and dose assessments, as well as analytical services for testing and monitoring indoor environments for both radiological and chemical contaminants.

The RIENL also conducts studies in radiation-contaminated areas and performs site-specific computer modeling and dose assessments.

Finally, RIENL provides scientific and technical expertise for EPA headquarters and regional programs, Federal agencies, State and local governments, and private industry. It has multi-disciplinary teams with broad ranges of expertise in health physics, physical sciences, chemistry, environmental sciences, engineering, and administrative support. The cooperative interaction between its environmental specialists in the field and scientists in the laboratory assures thorough management from sample collection through analysis to data interpretation.

Orphan Sources

If equipment containing a sealed source is disposed of improperly or sent for recycling as scrap metal, the sealed source may become "lost" and be sent to a metal recycling facility or into the possession of someone who is not licensed to handle the source. Specially licensed sources bear identifying markings that can be used to trace these sources to their original owners. However, some sources do not have these markings or the markings become obliterated. In these cases, the sources are referred to as "orphan sources" because no known owner can be identified. They are one of the most frequently reported radioactive contaminants in shipments received by scrap metal facilities.

The Agency is funding the first national program to systematically address the problem of "orphan radioactive sources." The Orphan Sources Initiative is a cooperative effort with the Conference of Radiation Control Program Directors (an organization of State radiation protection agencies) that is designed to assist States in retrieving and disposing of radioactive sources that find their way into non-nuclear facilities, particularly scrap yards, steel mills, and municipal waste disposal facilities. The program will also help people at these facilities recognize and safely secure radioactive sources.

One goal of the program is to establish a nationwide disposition system that provides quick and effective identification, removal and disposition of orphan sources, which if undetected, can present a health hazard and cost facilities millions of dollars in lost production and decontamination expenses. Disposition may include recycling, reuse, or disposal. Another goal for the program is to provide to those who may dissolve unwanted radioactive sources at their facilities.

The Orphan Sources Initiative, in which EPA enlists the participation of States and other Federal agencies with radiation protection responsibilities, i.e., NRC and DOE, will focus on developing a nationwide program for controlling for orphan sources. This initiative will address both locating and properly disposing of current orphan sources and preventing future losses of radioactive sources.

SUPPORT FOR OTHER EPA OFFICES

Contaminated Site Cleanup

The EPA's Radiation Site Cleanup Program uses the best available science to develop risk assessment tools and guidance for cleaning up sites that are contaminated with radioactive materials. The Cleanup Program also provides technical support and expertise to EPA's Superfund program. Published reports, guidance documents, and fact sheets address the following topics: risk assessment using radionuclide slope factors; stabilization/solidification processes for mixed waste; management options for laboratory generated mixed waste; radiation and mixed waste incineration; electrokinetics remediation; and computer groundwater modeling for radioactive and mixed-waste contaminated sites. The EPA is collaborating with other Federal agencies that have radiation protection responsibilities to develop consensus protocols for site cleanup and analytical laboratory methods (see the preceding MARSSIM AND MARLAP sections).

EPA Regions

The EPA has 10 regional offices distributed across the country to ensure that each State is served by the Agency's programs. The ORIA provides support for the radiation programs in those regional offices as requested. The most frequent areas of concern for the regions are: emergency response; public education regarding radon; NESHAPs enforcement; supporting the clean-up of radioactively contaminated sites; and providing technical assistance to the States in their regions.

EXAMPLES OF EPA STANDARDS

The Agency has issued standards to implement the authorities cited above. To give the reader an idea of the issues addressed in such standards, two examples are discussed below.

40 CFR Part 191

In 1985, under the authority of the AEA, EPA issued its generally applicable environmental standards for the management and disposal of HLW, spent nuclear fuel (SNF), and transuranic radioactive (TRU) wastes, *Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes.* These standards are found in Part 191 of Title 40 of the Code of Federal Regulations (40 CFR Part 191). Many parties filed law suits and, in 1987, a Federal Court returned the disposal standards to the Agency. The EPA issued the amended 40 CFR Part 191 disposal standards in 1993. These standards have been applied to WIPP and another DOE facility.

The standards today consist of three sections. The first section of the standards sets a dose limit for members of the public from the management and storage of these wastes prior to disposal at waste management and disposal facilities regulated by NRC and at those DOE disposal facilities that are not regulated by NRC. The annual limits are on exposures received through all pathways and consist of: (1) 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other critical organ for facilities regulated by NRC and (2) 25

millirems to the whole body and 75 millirems to any critical organ for DOE disposal facilities that are not regulated by NRC.

The second section contains long-term containment requirements that limit projected cumulative releases of radionuclides into the accessible environment for the first 10,000 years after disposal. The basis of the release limits is the amount of each radionuclide that, under assumed pathways, would result in 1,000 fatal cancers over 10,000 years from 100,000 metric tons of heavy metal. There is also a limit on the annual dose that can be imposed on a member of the public within the first 10,000 years, i.e., 150 microsieverts (μSv). In addition, the second section contains six qualitative assurance requirements to provide additional certainty that the containment requirements will be met: (1) active institutional controls should be maintained for as long a period of time as is practicable after disposal; however, performance assessments shall not consider any contributions from them for more than 100 years after disposal; (2) disposal systems shall be monitored after disposal to detect substantial and detrimental deviations from expected performance; (3) disposal sites shall be designated by passive institutional controls to indicate the dangers of the wastes and their location; (4) disposal systems shall use both engineered and natural barriers to isolate the wastes from the accessible environment; (5) places where there has been mining for resources, or where there is a reasonable expectation of exploration for scarce or easily accessible resources, or where there is a significant concentration of any material that is not widely available from other sources, should be avoided in selecting disposal sites. Resources to be considered shall include minerals, petroleum or natural gas, valuable geologic formations, and ground waters that are either irreplaceable because there is no reasonable alternative source of drinking water available for substantial populations or that are vital to the preservation of unique and sensitive ecosystems. Such places shall not be used for disposal of the wastes covered by this part unless the favorable characteristics of such places compensate for their greater likelihood of being disturbed in the future; and (6) disposal systems shall be selected so that removal of most of the wastes is not precluded for a reasonable period of time after disposal.

Finally, the third section contains ground-water-protection requirements. The limits are the same as those that apply to all underground sources of drinking water in the United States, the MCLs mentioned previously. They are: 5 pCi/L for radium-226 and –228; 15 pCi/L of gross alpha activity (including radium-226, but excluding radon and uranium); and 40 μSv/year from combined beta- and photon-emitting radionuclides.

40 CFR Part 197

The EnPA gave EPA a new authority, i.e., to develop site-specific environmental radiation protection standards for the potential SNF and HLW storage and disposal system in Yucca Mountain, Nevada. The EnPA also directed EPA to set the standards “based upon and consistent with” the results of a study by the National Academy of Sciences (NAS) "to provide [to EPA]...findings and recommendations on reasonable standards for protection of the public health and safety…." The standards, issued in 2001, are found in 40 CFR Part 197.

The 40 CFR Part 197 standards, as issued in 2001, had four major parts: (1) individual-protection during the pre-closure phase; (2) individual-protection during the post-closure phase; (3) human-intrusion during the post-closure phase; and (4) ground-water protection during the post-closure phase. The storage standard is 150 μSv annual committed effective dose equivalent (CEDE) to any member of the general public. The disposal standards are: (1) 150 μSv annual

CEDE for the reasonably maximally exposed individual[1] (RMEI) for 10,000 years after disposal; (2) 150 μSv annual CEDE received by the RMEI within 10,000 years after disposal as a result of human intrusion; and (3) the levels of radionuclides in the ground water cannot cause annual individual doses to exceed: (1) 40 μSv per year from beta- and gamma-emitters or (2) 5 pCi/L of radium-226 and -228 or 15 pCi/L of gross alpha activity. There were also requirements related to the post-10,000-year period, the basis of compliance judgments, and performance assessments.

Shortly after the standards were issued, challenges were filed in Federal courts by the State of Nevada and several organizations. The standards survived every challenge except one regarding the compliance period. The Court ruled that the 10,000-year compliance period was not based upon and consistent with a recommendation in the NAS Report, specifically:

> "…there is no scientific reason for limiting the time period of an individual-risk standard in this way [10,000 years]. We believe that compliance assessment is feasible for most physical and geologic aspects of repository performance on the time scale of the long-term stability of the fundamental geologic regimes – a time scale that is on the order of 10^6 years at Yucca Mountain – and that at least some potentially important exposures might not occur until after several hundred thousand years. For these reasons, we recommend that compliance assessment be conducted for the time when the greatest risk occurs, within the limits imposed by long-term stability of the geologic environment."

In 2005, the Agency proposed amendments to address the Court ruling. The proposed amendments would retain the individual-protection standard established in the 2001 standards, up to 10,000 years. In addition, the compliance period for the individual-protection and human-intrusion standards would be increased to 1 million years and the annual CEDE limit between 10,000 and 1 million years would be 3.5 millisieverts. There are also proposed requirements for the way performance assessments and the dose calculations would be conducted.

FOR FURTHER INFORMATION

If you would like more information on ORIA, please visit http://www.epa.gov/radiation/.

REFERENCES

1. "Public Health Service Act", 42 U.S.C. 201 et seq. (1944).
2. "Atomic Energy Act", 42 U.S.C. 2011 et seq. (1946).
3. "Clean Air Act", 42 U.S.C. 7401 et seq. (1970).
4. "Clean Water Act", 33 U.S.C. 1251 et seq. (1972).
5. "National Oil And Hazardous Substances Pollution Contingency Plan", Title 40 of the Code of Federal Regulations, Part 300 (1994).
6. "Safe Drinking Water Act", 42 U.S.C. 300f et seq. (1974).

[1] The RMEI concept is similar to the critical group concept in that its purpose is to project doses that are within a reasonably expected range rather than the highest theoretical dose. This is accomplished by using cautious, but reasonable, parameter values and is to be based upon the common lifestyle downgradient from Yucca Mountain. Ground water is assumed to be withdrawn from the highest concentration in the plume of contamination outside the site and to be consumed by the RMEI at a rate of two liters per day and a portion of the diet to be from locally grown food that was grown using contaminated ground water.

7. “Comprehensive Environmental Response, Compensation, and Liability Act”, 42 U.S.C. 9601 et seq. (1980).
8. “EPA's National Priorities List”, Title 40 of the Code of Federal Regulations, Part 300, Appendix B (2007).
9. “Nuclear Waste Policy Act”, 42 U.S.C. 10101 et seq. (1982).
10. “Nuclear Waste Policy Amendments Act”, Public Laws 100–202 (101 Stat. 1329–121) and 100-203, 101 Stat. 1330−243 (1987).
11. “Waste Isolation Pilot Plant Land Withdrawal Act”, Public Law 102-579, 106 Stat. 4777 (1992).
12. “Energy Policy Act”, Public Law 102-486, 106 Stat. 2921 (1992).
13. “Environmental Radiation Protection Standards for Yucca Mountain, Nevada,” Title 40 of the Code of Federal Regulations, Part 197 (2001).
14. “Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations”, Title 40 of the Code of Federal Regulations, Part 194 (1996).
15. “Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities”, Title 40 of the Code of Federal Regulations, Part 266 (2001).
16. “Multi-Agency Radiation Surveys and Site Investigation Manual”, U.S. Environmental Protection Agency, the Departments of Defense and Energy, and the Nuclear Regulatory Commission (2000).
17. “Multi-Agency Radiological Laboratory Analytical Protocols Manual”, U.S. Environmental Protection Agency, Departments of Energy and Defense, Nuclear Regulatory Commission, National Institute of Standards and Technology, U.S. Geological Survey, and U.S. Food and Drug Administration (2004).